EXERCISE AND LONGEVITY.

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LIFE as commonly regarded is opposed to death, and the desire to prolong life is therefore a natural and a commendable one. It is interesting to inquire how much the present fondness for physical exercises and athletic sports is contributory to this end.

In order that we may understand what exercise does for the body it will be necessary to know something of its structure and functions. According to modern physiology, our material body is composed of innumerable atoms and cells which have been built up into various tissues, bones, muscles, organs, etc. Many of these cells correspond to the lowest forms of animal life and as such have their period of birth, activity, and death just as other living organisms do. In his simplest state a man may be regarded as a community of organisms capable of doing a certain amount of physiological work. The nature of the work consists in the maintenance of (1.) animal heat, termed calorific work, the maintenance of (2.) nervous or vital power, termed internal work, and the maintenance of (3.) mechanical energy as muscular power, termed external work.

Representing the standard of measurement by the force required to raise one pound one foot high, the amount of force expended daily by a man weighing 150 pounds in the performance of these different kinds of work has been calculated to be about 3,400 foot tons, *i. e.*, the amount of force necessary to raise 3,400 tons one foot from the ground. This expenditure is divided as follows :

Calorific work	2,840	foot tons.
Internal "	260	" "
External "	300	" "
	3,400	" "

In order to meet this expenditure of force and maintain a footing in the world a man must not only consume a certain amount of food, but he must see that this food is impartially distributed throughout his entire organism, and that every function gets its just share of the body's nutriment.

We have seen that only 300 foot tons of force or energy, or about 11 per cent. of the total amount available, can be expended in muscular work and still leave enough for the performance of vital functions. A consideration of the nature, amount, and method of physical exercise necessary to maintain health and secure longevity is, therefore, of vital importance.

Regarding man as a community of atoms and cells, we find, singularly enough, that he flourishes as an individual in proportion to the death of these cells. This local death is going on at every moment and in every part of the living body. Individual cells are incessantly dying and being cast off, to be replaced by others, which are as constantly coming into separate existence. This process of decay and death is greatly influenced by the activity of the bodily functions, which are all stimulated by muscular exercise.

But exercise is not only the chief agent in the destruction of the tissues ; it is also the chief agent in their renovation and repair. Through its influence on respiration and circulation new material or liquid food is hurried forward in the blood, and the waste substance resulting from the oxidation is borne away more rapidly by the same agency. Thus it may be easily shown that judicious exercise not only improves the condition of all the muscles brought into action, but through its stimulating effects upon the vital organs the health and tone of every other part of the system is improved.

If, on the other hand, the exercise is not judicious, that is, if it does not give sufficient employment to all the different muscles and organs, or if it is too partial, one sided or excessive or if it is taken under unfavorable atmospheric conditions or constrained attitudes or positions, the results which follow will not be satisfactory, but will surely tend to disease and death.

The physical effects of following too exclusively the different occupations of life furnish illustrations to the point. The sedentary life of the student, teacher, artist, clerk, lawyer, etc., gives ample opportunity for the development of the brain, but

unless some time is given to physical exercise, the brain will be nourished at the expense of the other organs. Sluggishness of the liver, constipation, and digestive troubles will soon follow, and unless relief is afforded, a diseased condition will become established.

The evil effects of using excessively small groups of muscles is illustrated in the cramps and paralyses of penmen or writers, pianists, engravers, violinists, seamstresses, and telegraph-operators. Public singers, speakers, actors, clergymen, and auctioneers are frequently sufferers from a strained and swollen condition of the vocal cords and larynx, familiarly known as "clergymen's sore throat," and musicians who play on wind instruments are subject to distension of the air cells of the lungs in consequence of the strain brought to bear upon them by the powerful use of the expiratory muscles. Porters, draymen, heavy ironworkers, and a certain class of athletes often illustrate the effects of an excessive use of the muscular system. Where the body's nutriment is expended in this direction the impairment of heart or lung tissue is likely to follow.

The results of working in a strained position of the body is shown in the lives of printers, compositors, and pressmen, shoemakers, cabinet-makers and tailors. Dyspepsia, diarrhœa, catarrh, pneumonia, and consumption are frequent among printers; while catarrh, rheumatism, and sciatica afflict the lives of the coopers. Ruptures and swollen veins in the lower extremities are common among carpenters and consumption cuts off a large portion of the cabinet-makers. Shoemakers and tailors are made flat-chested and round-shouldered by their occupations, and the muscles of the legs frequently become flaccid and withered from disuse. Constipation, sciatica, and muscular pains in the back and a predisposition to consumption are the prevailing tendencies in these two occupations.

While fresh air is an excellent thing, continuous exposure to the extremes of temperature or exposure to alternations of cold and heat, and to wind, rain, and snow renders one liable to bronchial catarrh, pneumonia, and rheumatism. Boatmen, fishermen, farm-laborers, hack, omnibus, and cart drivers are frequently afflicted with pulmonary affections and rheumatism. Bakers and cooks, blacksmiths and engineers and stokers who are exposed to extremes of heat are similarly affected.

The bad effect of inhaling impure air in the form of irritating, poisonous, or offensive vapors and gases, or of irritating and poisonous dusts of animal, vegetable, or mineral origin, may be illustrated by the prevailing disorders among the laborers in a great variety of occupations which abound at the present day. Catarrhs, bronchial affections, skin eruptions, digestive troubles, and consumption are the diseases that most afflict the workers in metals and various mineral and vegetable compounds.

These are only a few of the occupations that tend to impair health and shorten life. In many instances this unfavorable tendency is due to the poor sanitary conditions under which the work is carried on. In other cases inherited weaknesses may render some persons susceptible to disease. But, in the main, the division of labor which calls into prolonged activity only a few of the faculties at a time is largely responsible for the tendency to physical degeneracy. Where once a man's employment was sufficiently varied to give him all the activity necessary to keep him in health, he now has to give what health he has to his employment and trust to other means to keep up his physical condition.

If the individual is especially ambitious to succeed and devotes himself assiduously to his chosen work without taking time for recreation, he may win the reputation of being the most skilful mechanic, the wealthiest merchant, or the ablest lawyer in the community; but unless he is extraordinarily endowed with physical resources he will probably pay for his distinction by a disordered liver, enfeebled digestion, or weak lungs. In other words, the tendency of our civilization is to build up the trade, industry, profession, or institution at the expense of the individual.

In this respect the institution or community in the social organism resembles the individual in the human organism, and as the human organism flourishes in proportion to the activity, destruction, and renovation of its individual atoms, so the institution and the community flourish in proportion to the activity, death, and replacement of human individuals.

Where life is the most rapid and intense, civilization is most advanced, but death is the most imminent. This is familiarly illustrated in the life of our large cities, which have become like so many great furnaces where human individuals are consumed

in order to keep the machinery of our complex social organism in motion.

To many of my readers this may seem to be a rather uncheerful view of life, and it may well be asked, Is this destruction of the individual necessary? This depends upon our idea of progress and civilization. If it is deemed necessary to crowd the normal work of an age into a century in order to realize the greatest prosperity, this rapid progress can only be attained by the sacrifice of individual strength, health, and completeness.

A certain portion of our community recognize this fact and are making strenuous efforts to change the standard and realize higher ideals of human progress.

Although the division of labor narrows individual life, and in many cases restricts individual development to a few muscles and faculties, it shortens the hours of labor and presents opportunities for improvement in other directions. In communities where efforts are made to improve the physique of the individual and better the sanitary conditions of his surroundings, life has been made longer and happier. This is especially true in countries that have given attention to public health and personal hygiene.

The average life of the individual in England, for instance, has been raised from 28 to 34 years of age within the past century, in spite of the rapid growth of large cities with their inevitable crowd-poisoning and intense struggles for existence.

The establishment of working boys' clubs, church and Y. M. C. A. gymnasiums, athletic associations, and physical recreation societies has done a great deal to improve the physical condition of the masses; while the golf, tennis, rackets, horseback riding, bicycling, rowing, and the track and field sports are contributing much to the physical condition of the well-to-do classes.

The grand aim in all sports and athletic exercises should be to make them supplement as far as possible the deficiencies in one's life-work or occupation.

Where the heart or lungs are weak from inactivity or breathing poisoned air, every effort should be made to improve the condition of these organs by appropriate exercises, such as gentle running, rowing, etc. Where the muscles are soft and flabby from disuse, they should be strengthened by the use of dumb bells, Indian clubs, or chest weights, and so on through the wide range of developing and recreative exercises, which are admirably

calculated to strengthen and improve the weak points in one's organism.

Many of the athletic sports, if pursued for sport or as a recreation, are valuable remedial helps, and aid toward physical improvement. Unfortunately, the spirit of emulation in athletics, which in some communities has grown into intense rivalry, is likely to lead to excesses in training and practice for contests, which, unless checked and brought down to a rational basis, may do more harm than good. Many young men seem to think that because the practice of athletics is favorable to health the more they can get of this practice the better. This is an erroneous impression, for it is as possible to overwork in athletics as it is in business, and a great many young people do themselves injury by their excessive zeal in the practice of competitive exercise.

In this line of physical activity, as in any other, there is a limit to human capability, and it is possible to develop the muscular and nervous systems to the detriment of the heart and lungs or of the digestive system. But the conditions under which athletics are usually practised are so favorable to the maintenance of health and vigor that few persons who were sound at the time of commencing their athletic efforts have injured themselves by the practice of these vigorous exercises. It is true that a certain number of young men who were distinguished for their supremacy in certain athletic events have died young. But the number of young men who are now practising athletic exercises in this country and appearing in public contests is very large, as many as six or seven hundred entries being recorded in some of the great city meetings.

Where the yearly mortality in most of our towns and cities is about 20 to every 1,000 inhabitants, it is quite natural that the name of some young man who had practised athletics in this athletic age should be among that fatal number. It would be unwise to infer that his death was caused by athletics unless his condition was known previous to the time of his entering athletic contests, and the life he had led during his so-called athletic career. I regret to add that a great many of the physical breakdowns which are attributed to athletics have their origin in irregular, and in some cases dissolute, habits of living. Every man who rises to eminence in his trade or profession must

undergo necessarily more than the ordinary mental and physical strains of life. Notwithstanding this fact, some of the foremost men of the world have exceeded the allotted period of three score years and ten. Perhaps their lengthened lives were the important factor that contributed to their eminence.

Some of these men have been noted for their great athletic vigor as well as their intellectual achievements. Such men were Brougham, Lyndhurst, Peel, Campbell, Graham, and Palmerston, of England. Sir Walter Scott and Professor Wilson and Robert Burns, of Scotland, were also distinguished for their athletic abilities. So were Gladstone and Bismarck of the present day.

To come nearer home for illustrations of prominent men of old age who practised systematic physical exercises, reference may be made to the poet Bryant, who used his dumb bells daily up to the time of his death, though he lived to be 84.

The historian Parkman was a good boxer while in college, and kept up some form of physical exercise throughout his life. He died aged sixty years.

The leading essayist in America to-day, who is now verging on his seventy-fourth year, has always been fond of gymnastics and athletic sports, and took his daily swim in summer time until a few years ago.

The president of one of our foremost universities, and a distinguished scientist and patron of education, who are both past sixty, were prominent oarsmen in college, and now have recourse to yachting and horseback riding to keep them in good working condition.

An eminent naturalist, and one of the hardest-working men whom it is my pleasure to know, was a good all-round athlete in his younger days, though originally not of a strong constitution. Only a year or two since, while making a geological survey off the coast of Florida, he was capsized and remained in the water swimming and clinging to the boat for several hours. Although now approaching sixty years of age, he is in regular attendance at the college gymnasium, and takes his exercise energetically and systematically.

The effect of practising violent forms of competitive exercise for a considerable period of one's life is commonly supposed to be injurious. No less an authority than Dr. Benjamin Ward Richardson says in his "Diseases of Modern Life" that "there is

not in England a trained professional athlete of the age of thirty-five, who has been ten years at his calling, who is not disabled."

We cannot help thinking that his statement is an exaggeration. While it may be true that men beyond thirty-five years of age very rarely attain championships in any athletic contests, men who have attained great distinction as athletes frequently live and enjoy good health up to sixty, seventy, eighty, and even ninety years of age.

Henry Clasper, the English oarsman, rowed in 110 different races, most of them over four miles in length, and won several after he was forty-seven. William Belden, the Nestor of cricket, lived to be ninety-six. John Bowyer, another famous cricketer, lived to be over ninety. James Taylor, another excellent oarsman of England, rowed in 112 different races. Jem Ward, the English pugilist, died at ninety-five, and Jem Mace, at one time the English champion, is still living and teaching sparring, although he is seventy-six.

Blondin, the French gymnast who crossed Niagara on the tight rope in 1855, '59, and '60, died but lately at seventy-two years of age. Many of the distinguished circus performers in England lived to be well along in old age, including the great Astley, who died at seventy-two ; Pablo Fanque, at seventy-five ; Madam Saqui, at eighty, and Saunders, at ninety-two.

In our own country many of the old circus performers are still living. Perhaps one of the most distinguished is Eaton Stone, the once famous bare-back rider. He is now living in New Jersey, aged eighty-one. Many professional athletes and instructors in physical exercises can be recalled who have certainly been subjected at times during their lives to great physical strain. Among this number may be mentioned Wm. Wood, of New York city, who is now living and in active business at the age of seventy-eight; Professor Andrews, of Brooklyn, who is still teaching gymnastics at sixty-one; and George Goldie, of Princeton College, who is also engaged actively in teaching and performing heavy gymnastics at the age of fifty-six. There are several prominent Scotch athletes in America who are now over seventy years of age.

Among amateur athletes who have passed middle life may be mentioned William B. Curtis, of New York. Mr. Curtis has probably engaged in a wider range of athletic exercises and kept

in practice a longer term of years than any other man in America. For this reason he is frequently referred to by the younger generation as the "father of athletics." Notwithstanding his violent physical efforts in the past he is able at the age of sixty to accomplish a large amount of intellectual work and still enjoy vigorous exercise in walking, swimming, and skating.

In one or two cases I have known of men actually acquiring an increase of physical vigor and physical measurements after the age of sixty by the practice of systematic exercises. Mr. Smith Robertson, of Eau Claire, Wis., a man five feet eight inches in height and weighing 140 pounds, began systematic exercise with 10-pound dumb bells and a horizontal bar when sixty-nine years of age. He worked with this apparatus for about ten minutes a day, and walked from four to six miles a day regularly for a period of three years. At the end of this time he found that his weight had increased from 140 to 160 pounds, his chest measurement had increased from 36 to 40 inches, and all the other muscles of the body proportionateiy. At the present time he weighs 165 pounds and is 83 years of age, yet he writes me that he can walk or run almost as easily, and with apparently the same elasticity, as 50 or 60 years ago.

Upon reviewing the lives of these prominent athletes and gymnasts, many of whom I have known personally, the facts that come most prominently to my mind are the wide range of exercises in which they have engaged and the sensible way in which they have taken care of themselves, even under unfavorable conditions.

From these observations I think we may conclude that violent physical efforts are not incompatible with the attainment of a fairly long life, provided the individual has a sound constitution to start with, strengthens his whole system by the practice of a variety of exercises, and gives careful attention to his habits of living. Nevertheless, as very few persons are endowed with the constitutions out of which athletes are made, it would be a safe rule for most persons to refrain from indulgence in violent physical efforts if they value their health and desire longevity.

The body as a whole is no stronger than its weakest part, and when a person is subjected to a severe strain it is the weak spot that is likely to give way, and lay the foundation for disease. Instead of working under high pressure for a short time, much

more can be accomplished, and with less risk to health, by working under a low pressure for a longer time.

In my opinion the chief requisites are that the working conditions be as favorable as possible, and that the efforts be sufficiently varied to bring all of the bodily functions into action: oft-repeated efforts of mind and body with frequent intervals of rest.

> "By ceaseless action all that is subsists.
> Constant rotation of the unwearied wheel
> That Nature rides upon, maintains her wealth,
> Her beauty, her fertility. She dreads
> An instant's pause, and lives but while she moves."

According to our premises, there is no other way in which the individual parts of the organism can be properly nourished and sustained except by activity, and upon the health and tone of the individual units depend the health, strength, and endurance of the body as a whole.

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